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THE 1951 KANSAS CITY FLOOD

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HYDRAULICS DIVISION

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THE 1951 KANSAS CITY FLOOD

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SYNOPSIS

This review of the 1951 flood in the Kansas River Basin emphasizes the effect on industry in the flood plains. The record-breaking flood caused nearly 500 million dollars' damage in the Kansas Citys, but loss of life was small. Industrial buildings suffered in varying degrees, with deposition of silt a major factor affecting final "cleanup." Industry is rebuilding on old locations as the reservoir program, started prior to the flood, is speeded up to supplement local levee systems.

The great 1951 flood on the Kansas (Kaw) River, which peaked at the Kansas Citys on July 14, ranks as a major calamity in the history of the nation. This importance rests chiefly on the staggering monetary loss in the order of 800 million dollars and, fortunately, not on extensive loss of life. Also, as a result of this loss, individuals and business concerns were permitted to make tax adjustments which resulted in about one-quarter billion dollars in lost tax revenue. The Kansas River crested at over 500,000 second-feet at Kansas City, its largest flood in modern times. The damage in adjacent rural areas was tremendous, the interruption to transportation and business long continued, and the destruction in industrial areas of the Kansas Citys almost fantastic.

It is this last aspect of the flood, the effects on industry and its recovery therefrom, with which this presentation deals. Transportation, public utilities, the vast rural damage and the plight of 90,000 displaced persons, are factors which cannot be ignored by anyone making an overall appraisal of the flood. However, they are largely excluded from this discussion which is generally restricted to the flood and its relation to industry in the bottom lands of the Kansas and Missouri Rivers in Kansas City, Missouri; Kansas City, Kansas and North Kansas City, Missouri.

There will be presented, in order:

- 1) The physical development of the area with which we are concerned;
- 2) Experience of the area during previous floods;
- 3) The status of protection works in 1951;
- 4) The events and effects of the flood;
- 5) The operation of recovery from the flood;
- 6) General conclusions and appraisal of the future.

A geographical description of the flooded area will assist in an appreciation of the events and their consequences. The Kansas (Kaw), draining 60,000

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square miles, joins the Missouri (which, above this point, drains an area of 420,000 square miles) in the very heart of the Kansas City metropolitan complex. Along the Missouri River, the bluffs adjoining the flood plain are in the order of three miles apart; along the Kaw, they are somewhat less—about a mile and a half at the confluence. Both rivers in nature have followed the sinuous course which is characteristic of alluvial streams, and at one time or another, in relatively recent centuries, have no doubt occupied every portion of their respective bottoms. However, with the passage of years and the restrictions established by man, their courses in the area under consideration have become well established.

The history of the Kansas City has recorded steady growth and expansion. Of course, the metropolitan area reached out in all directions to the hills and prairies adjoining the great bottom lands, but always the solid core of this growth was the concentration of substantial industry in the flood plains along the river. In these bottom lands, industry found those things it wanted and as its techniques improved through the years it leaned more heavily on these things. It found itself well served by river, rail, highway, and air. It found that it had a reliable water supply for processing and cooling operations, soil of good supporting capacity, proximity to the business and hotel districts, accessibility to the residential districts, steady supplies of electric power, petroleum products, and ample bridge facilities. The availability of water for processing and cooling steadily increased in importance and, of course, an ample supply was found in the bottoms.

The type and virility of this industry has enabled the Kansas City to attain top or near-top rank as a cattle and wheat market, as a meat packing center, in grain elevator capacity, and as a flour milling, farm implement, and seed center. In the processing and distribution of food, petroleum, and rubber products, steel and soaps, in automobile and airplane assembly, and as a transportation hub served by 12 rail trunklines, 6 airlines, and 140 trucking companies, Kansas City has attained national distinction.

The principal areas concerned are those industrial districts known as Argentine, Armourdale, Central Industrial, Fairfax, and North Kansas City, comprising 11,000 acres. (There are other industrial districts in the metropolitan bottom areas, but happily they were not directly involved in the events of July 1951.) All five of those noted were flooded, except North Kansas City. Argentine and Armourdale contained both industrial development and housing of the single-family, frame type. Central Industrial District was almost entirely industrial, the buildings generally being multi-story brick construction of the type common to the period 1900 to 1920. Fairfax, a recently developed district without residential construction, consisted of single-story, ultra-modern industrial facilities. North Kansas City was even more diversified in types of improvement than the other districts, since it included an airport and large housing areas. Property in the bottom lands had a total value of between 1-1/2 and 2 billion dollars at the time of the flood, with a business volume of about 3-1/2 billion dollars annually. Employment was over 80,000 persons, with an annual payroll of about 270 million dollars.

Some of the firms prominent in this industrial panorama had weathered the 1903 flood; others had located in the area during and after World War I, and many represented a substantial expansion in recent years. The entire Fairfax District had been built since 1928. Names well known nationally and regionally were common throughout the area. In the Argentine District, for example, the multi-million dollar installations of the Santa Fe Railroad, the Sinclair Refining Company, the Kansas City Structural Steel Company, were

some of the larger occupancies. In the Armourdale and Central Industrial Districts were located the large plants of the soap and detergent manufacturers, such as Colgate-Palmolive Company and Proctor & Gamble; the large plants of major packers—Armour, Cudahy, Swift and Wilson; the pens of the Kansas City Stock Yards and the large farm implement and equipment concerns, such as John Deere and Columbian Steel Tank.

To the north along the Missouri River could be seen the comparatively new Fairfax Industrial District—a most impressive sight, and, it is believed, the most highly restricted industrial area anywhere. The new plants here included such organizations as General Motors, Owens-Corning Fiberglas, Sunshine Biscuit, Trans-World Airlines, Phillips Petroleum Corporation, International Harvester, Jones & Laughlin Steel, The Darby Corporation, Chrysler, Firestone, Goodyear, Goodrich, Kraft Foods, American Can, and many others. In Fairfax, at the time of the flood, the value of the development was estimated at nearly 200 million dollars and was increasing at the rate of about one million dollars a month.

These areas, located as they are at the junction of the Kansas and Missouri Rivers, were no strangers to floods in the past. Probably the highest local flood stage in modern times, as deduced from high-water marks, occurred in 1844. What a flood of that magnitude meant to industry was of no special concern at that time, as the area was only sparsely settled. However, it was a different story in 1903 when both the Kansas and the Missouri Rivers combined to flood the area, which by that time was highly improved for industrial use. These large districts were then well developed industrially to form a center of business activity, and all around there was unmistakable evidence that this was becoming the business and commercial gateway to the West.

In 1903, floodwaters, generated by intense rains over the already waterlogged Kansas and Missouri River basins, raced through the bottoms, pouring into second-story windows of wholesale houses, packing houses, and factories. Fifteen of the sixteen bridges across the Kansas River were washed out. The combined discharge of the two rivers was about 548,000 second-feet, with the Kansas River contributing at least 260,000. Floodwaters spread over 25 square miles in the flood plain. The damage was estimated at 23 million dollars in an area valued at about 80 million dollars, 1903 prices. (If 1951 prices had prevailed, the figures would have been 120 million dollars damage in an area valued at 420 million dollars.)

Physical recovery from the 1903 flood was comparatively slow, transportation being substantially shut off for several weeks. Although several thousand laborers were put to work, and industry itself attacked the cleanup problem energetically, this was before the day of modern motorized equipment, so that the task was long and tedious. Even before the floodwaters had receded, the slogan, "It Must Never Happen Again," was coined amidst efforts of local interests and industrialists to erect some manner of protection works which would protect the rich developments in the flood plain.

Along the Kansas River, these interests formed the Kaw Valley Drainage District, an organization which exists today, and proceeded to widen the river channel and build nine miles of substantial levees on each side. Later, the bridges were raised to provide additional floodway. These early works represented an expenditure of over 7 million dollars by local interests and provided moderate protection against floods in certain areas. With the aid of this protection, the areas successfully rode out several moderate floods, notably those in 1908, 1935, and the early 1940's. However, as industrial development in the area grew and as engineering knowledge of the probability

of future floods increased, there arose national as well as local concern over the absence of adequate protection against such possible floods.

In 1937 the Greater Kansas City Flood Protection Planning Committee employed the late Frederick H. Fowler, consulting hydraulic engineer of San Francisco and past President of the ASCE, to make an independent study of the situation. Mr. Fowler recommended the construction of storage reservoirs in the Kansas Basin to reduce flood flows, and the extension and improvement of levees and floodwalls to contain the residual flow. Mr. Fowler's recommendations, which were in harmony with the findings of the Corps of Engineers, formed the basis of later congressional authorizations and appropriations upon which the Corps designed the local portion of the protection system. This system was near completion at the time of the 1951 flood.

At the time of the flood, about 35 million dollars had been expended by the Federal Government on these local protection structures. The Federal expenditures were in addition to substantial local contributions for rights-of-way, relocations and maintenance and the cost of works previously built. The levees and floodwalls, averaging about 12 feet above ground level, extended 40 miles through the highly industrialized areas. Impressive as the local works appeared, all those familiar with flood control matters knew that these levees and walls were only a part of the answer to the problem. The levees were not designed to shield the lowland areas from major floods without the assistance of upstream reservoirs, and these reservoirs had not yet been built.

A brief picture of the precedent rainfall and runoff conditions in the Kansas Basin may help to better understand the effects of the 1951 flood. By July 2, after two months of almost incessant rain over most of the Kansas Basin, that river at certain points had established stages which approached the levels of the great flood of 1903. Industry and other development in the Kansas City still felt secure behind the levees, and there was general confidence that even if the discharge reached 1903 proportions most of the industrial areas would be kept dry. Hydrologists did not share the general belief that 1903 records were inviolate, but of course they did not yet know that new record stages and discharges were about to be set in such major amounts.

Beginning the night of July 9, intense rains fell over the southern portion of the Kansas Basin, and continued for three days. Total rainfall amounts for the period ranged from 11 to 18 inches and the runoff approached 90 percent over many sub-basins. The last 12 hours of this storm actually doubled the discharge that would have otherwise occurred in the Kansas River. Thus, this fatal 12-hour period constituted the difference between a reasonably large flow which probably would have passed the levees at the Kansas Citys and the major disaster which actually occurred. The most tragic result of this last 12-hour deluge was to destroy or damage many of the communication media above Kansas City and thus hamper the best predictions at a time when a few more hours' warning might have softened the blow.

The vanguard of this terrific flood hit the Kansas Citys "chute" on July 12. The water rose 6 inches an hour until it was within 2 feet of the top of the Argentine levee. Emergency flood fighting continued, but shortly before midnight at the end of that day the water overtopped the levee. On the 13th the flood swept across the Argentine District and in its surge to reach the outlet into the Missouri River inundated the Armourdale and the Central Industrial Districts to depths up to 30 feet. None of the new protection works failed structurally prior to overtopping; it was merely a circumstance of unprecedented and uncontrolled quantities of water overtopping the levees and walls by substantial margins—perhaps up to 9 feet.

The Fairfax District suffered a loss of over 90 million dollars when most of its 2,000 acres were inundated on July 14 to depths ranging from 4 to 12 feet. However, the levees were not overtopped; the initial entrance of water was caused by the failure of a covered sewer (Jersey Creek) which traversed the area. The weakness of this covered stream was well known to all concerned. As a matter of fact, a complete pressurizing job was under contract and equipment was at the site when the flood struck. Failure resulted from back-pressure developed by excessive stages in the adjacent Missouri River. If the authorized reservoirs in the Kansas Basin had been in operation, they would have reduced the hydrostatic head on the Fairfax levee. One cannot help but speculate whether the cover of the sewer would have held if the head had been so reduced. Should that have been the case, a substantial portion of the reservoir costs would have been paid during the one flood in an industrial area many miles from the dam sites.

Although the 1951 flood peak was of greater discharge and velocity than in 1903, the area inundated was considerably less. Four of the major industrial districts were spared inundation in 1951, although in one of them (North Kansas City) evacuation of the entire population was deemed necessary as a precautionary measure. A concentrated flood fight to stop severe erosion on the levee opposite the mouth of the Kaw was successful after several very critical days. By a fortunate act of providence, during the flood the Missouri River was at a relatively low stage, carrying only 60,000 second-feet just above its junction with the Kansas. Had the Missouri been at a reasonably high stage when the Kansas River discharged a half-million second-feet, the results would have staggered the imagination.

The flood attracted thousands of anxious sightseers who lined the bluffs on July 13 and ventured out on the few viaducts which were accessible. The Kansas bottoms were covered from bluff to bluff as the water moved on into the Missouri. The view was one of pandemonium—bawling cattle, squealing pigs, dislodged oil tanks; pieces of buildings and railroad cars were carried along the surface of the water acting as battering rams against the remaining structures. In many cases, the surging waters smashed through plant windows and doors carrying away valuable equipment, stocks and irreplaceable business records.

A bright aspect of the situation was that of the saving of human life. In spite of the short notice preceding the final inundation, thanks to the cooperation of police, military, naval and other officials, radio stations, and all concerned, only three lives were lost. Experienced Corps of Engineers' rescue teams, equipped with small outboard powered boats and radio, proved extremely effective in this operation. One special problem, while the flood was actually in progress, was that of the meat packers. Large stocks of processed meat were in coolers above the level of the water; however, the refrigerating machinery for these coolers was made inoperative by the flood. Much of this meat was evacuated by boats furnished by the Corps of Engineers and other agencies.

To the distress of flood were added those of oil-fed fires when a 6,000-gallon tank, partly filled with diesel oil, floated from its base and struck a fallen high-tension electric line and exploded, spewing burning oil over the water in the south part of the Central Industrial District. The flood, in a 7-block area, was turned to a sea of fire as the flames spread to lumberyards, buildings and stores. The fire burned for five days, causing damage estimated at some 10 million dollars.

Rail transportation through the Kansas Citys was almost completely halted.

Practically every food plant was out of commission, and important production for defense, including the large General Motors Plant, was stopped or seriously crippled. A general shutdown of all business in the Kansas Citys existed for 4-1/2 days and heavy power and water users were restricted for an additional 12 days. Unemployment claims were processed for some 15,000 workers; 1,500 separate business establishments were affected by the flood, ranging from small shops to multi-million dollar investments. Generally speaking, some 30 to 60 days elapsed before operations even approached normal.

The waters began to recede on July 14, but the Kansas River was not back in bank until July 21. The ground areas themselves remained waterlogged in some cases for as much as two to three weeks after the river had receded. Everywhere the scene was such as to discourage even a construction engineer. The general impression was one of desolation and confusion, dirt, and the stench from carcasses of dead animals. It was immediately apparent that the rehabilitation job would be immense. The water had entered the areas at high velocity, carrying a heavy load of silt. Wherever there was an eddy of any kind, this silt had been deposited to a very considerable depth. Even second-story levels had their share. As the water receded, the weight of the silt often crushed the weakened second floors and brought them to the ground. Silt plugged every opening the water could reach, including sewers and electrical conduits.

Railroad cars and carcasses of animals were strewn almost everywhere. Structural damage due to the current, the floating debris and the residual silt was particularly severe in the Armourdale District, and in Argentine the Santa Fe rail yards were in complete chaos. Industrial damage in these two areas was about 143 million dollars. Frame buildings, particularly one- and two-story ones, had generally been shoved off their foundations. The heavier brick bearing-walls of modern block structures had been more successful in resisting the flood; however, stores with large front windows usually had the windows knocked out as the current coursed through the buildings, completely destroying the contents.

In the Central Industrial District, the buildings in general were quite sturdy and, while many were old, they were substantial. Structurally speaking, they survived but they were covered with sediment and debris, including decaying organic matter from the wrecked stockyards, foodstuffs, and other perishable goods. The District was at a standstill for two weeks while streets and grounds were cleaned out with bulldozers; and offices, warehouses, and buildings were washed out with fire hoses. Industrial losses alone were about 134 million dollars.

Flooding in the Fairfax District was from backwater and almost free from strong current. The residual problems as the water left were more specifically "cleanup" in nature than those in the other areas. The cessation and subsequent curtailment of production, and the water damage to millions of dollars in plant equipment, raw materials, and supplies affected the economy of a region extending far beyond the borders of the Kansas Citys. This was particularly true in the case of Fairfax, because of the nature and variety of its most modern plants.

As the flood crest passed, civic interests in Kansas City moved promptly to the gigantic task of cleanup and rehabilitation. The problem was first attacked by interests in the affected districts organized into two groups—Disaster Corps, Incorporated, in the Missouri portion, and Defense Rehabilitation, Incorporated, in Kansas City, Kansas. Planning groups of city officials,

Chamber of Commerce and other civic leaders, and the industrial district officials were formed while the waters still were at second-story levels over most of the stricken area.

Important main traffic arteries had to be opened, pumping stations reached and cleaned out, and hazards to health and fire removed. For six days, members of these emergency groups, employees of the industries, and hired labor and equipment attacked the initial cleanup phase. It was a rubber-boat and shovel job against what at times appeared to be insurmountable odds. The Corps of Engineers had put into the effort its experience, equipment and manpower, providing particularly much needed phone and radio communication, financial responsibility, and assignment of tasks. Labor, represented by the A.F. of L. and C.I.O., agreed to an emergency wage rate of \$1.50 an hour, and contractors brought in equipment on a non-profit rental basis.

A trial period of 16,000 tough, hard man-hours on this organizational basis moved thousands of tons of debris; hundreds of cars and trucks were towed out of the clogged streets; and some progress made toward restoring critical drainage and sewage systems. After this first-line emergency work by local groups, the stricken area was divided into four districts and the Corps of Engineers took over, on a compensatory basis, the remainder of this essential work. Contracts were made with a number of contractors who were in a position to furnish the equipment and manpower needed for this second phase.

The removal of silt (estimated at over a million tons) was a major task still confronting the industrial areas. Although the streets had been cleaned earlier, the subsequent removal of muck and debris from within the plants and residences to the street areas had more than overcome the headway which had been made. However, the three weeks of cleanup and rehabilitation were completed by the Corps about the middle of August at a cost to the Federal Government of approximately 3 million dollars. Of interest from an engineering standpoint was the disposal of the million tons of muck. Most of it was piled near the mouth of the Kansas River where it was later dredged without harm into the Missouri during stages adequate to effect dispersal. The Corps, in addition, spent another 3 million dollars in the repair and restoration of local levees and other flood protection works in the Kansas City system. This work was undertaken as rapidly as access was gained to the damaged sections and was completed well before the spring rises in 1952.

And so ended the immediate and visible aspects of the great 1951 flood. Although some physical and psychological scars still remain, the Kansas Citys have substantially recovered from the flood. As a matter of fact, more than 100 million dollars' worth of new construction has been achieved in the area since that time. But this new investment was not placed in the flood plain without serious consideration on the part of industry. Trade associations and individual firms took stock of just how many businesses were affected, what type of construction suffered worst, what independent remedial measures could be taken, and what protection could be provided on a regional basis.

A survey of the bottoms showed that over 2,500 separate business properties had been damaged. On the basis of a capital investment amounting to nearly one and one-half billion dollars, the total losses were some 16 percent. In spite of this situation, only a relatively small number of business firms abandoned the valuable flood plain location for higher levels. No type of building seemed to have been immune from flood damage if subjected to the direct current. A large pumping plant, in spite of its deep foundation, was scoured nearly to the point of overturning. Block-type construction suffered heavily by the collapse of walls under the battering of floating debris. Even in

locations where lower velocities prevailed, the accumulated silt often loaded second floors or roofs to the point of failure.

A very few firms resorted to revised structural design in the process of rebuilding. The most common individual practice adopted as a precaution against flood was to protect business files and operating machinery. This usually took the form of arrangements for easy removal wherever this was feasible. Some attention was given to the possibility of providing flood insurance—a coverage which was practically non-existent in 1951. Several studies were made locally and on a national scale, but the results were rather uniformly negative. The subject has been ably discussed by Mr. H. Alden Foster, member, ASCE, in Separate No. 483, August 1954. His report was based on a report prepared in 1952 for the Insurance Executives Association. He stated that the insurance business has not been able to devise a method of providing specific flood insurance coverage on a basis acceptable to the public and at the same time in conformity with sound, insurance principles. There appears to be no reason that this statement, based on conditions in 1952, should be essentially modified as of today. Mr. Foster concludes, "A long-range program it appears that an accelerated flood control program, supplemented by such relief payments as are necessary on account of flood damage, would be more in the interest to the public than a program of so-called flood insurance which would not be self-supporting."

Industry, along with every thoughtful citizen, explored the possibility of assuring an earlier warning in the event of a future flood of major proportions. As previously pointed out, the 1951 overflow hampered the existing communication systems upon which the Weather Bureau depended for basic observations. Since that time, funds have been made available to provide a higher degree of assurance that the flow of necessary data will not be interrupted when an emergency arises. New facilities now available to the Kansas City River Forecast Center of the Bureau include a radar network for reporting on cloud cover, an electronic routing machine for quick correlation of converging flood flows, new Telemark gages, additional rainfall stations, and an organization of radio amateurs to help collect emergency data. The improvements have also contributed to the decision on the part of industry to stay in the low lands where water and transportation team with technical skill to produce wealth for the cities and their trade areas.

Of course, the precautionary measures examined are of a defensive nature. In case of disaster, all possible property should be salvaged, but industry and the Kansas Citys have very reasonably asked that the disaster itself be prevented. Everyone is now aware that in the Kansas Citys the local levees alone, good as they are, cannot cope with a major flood. They are intended to function together with upstream storage reservoirs which will be operated to reduce flood crests. Future flood flows such as those of 1951 must be materially reduced, so that only a manageable quantity of water passes the Kansas Citys. Such control will not only spare the Kansas Citys another financial disaster but will alleviate flood problems all the way up the lower Kansas Valley. In dry cycles, the assured minimum river flows will help bolster the purchasing power of the trade area up the Kaw.

The hundreds of millions of dollars in private property and wages lost in the Kansas Citys alone, the millions of dollars of taxes lost because of the destruction, the 40 million dollars spent to restore publicly-owned facilities, and the incalculable losses due to interruptions of business are gone forever. Our only profit can be to learn from our experience and avoid a worse disaster in the future. Kansas City industry, along with that in a score of large

cities, has decided to keep its investments in the valuable flood plains where it has thrived and grown for many years. The future of Kansas City, itself, is tied to the continued security of its industrial heart. The avoidance of another such flood requires the diligent prosecution of the reservoir program in the Kansas Basin. One of the major factors in the areal recovery from the flood was the healthy condition of business generally, which provided the financial cushion for prompt recovery from damages. The effect of a repetition of the 1951 flood, added to the commitments now in effect, would have a marked accumulative effect.

The second session of the 83rd Congress took a substantial step toward realization of this program when it passed House Document 642, an authorizing document for a considerable proportion of the proposed reservoirs in the Kansas Valley. Industry in the Kansas Citys hopes some day for the degree of security against flood and drouth envisaged decades ago by the citizens of this industrial center.

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